



Pop-1: First ever popcorn open pollinated variety in Pakistan

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Abstract

Popcorn is a delicious type of maize used for preparation of flakes. Its cultivation is very limited and is used just for eating purpose. It is interesting to note that there was no approved popcorn variety in Pakistan. Pop-1 is the first approved popcorn variety recommended for general cultivation. It was developed through recurrent selection focusing the popping expansion and grain yield. After its development it was evaluated in comparison with a local landrace in station trials as well in National Uniform Maize Yield trials across the country. It gave a higher yield than the check variety in station as well national Trials respectively. The variety was found to be moderately resistant to stalk rot caused by *Fusarium moniliform* during two seasons hence showed a stable resistance against the disease. Agronomic investigations revealed that the variety performed better on ridges with row to row distance of 75cm and plant to plant distance of 12.5cm during Kharif season while a plant to plant distance of 20cm during spring season was optimum for getting maximum grain yield. Approval this variety will result in provision of high quality popcorn in the country and will also reduce its import subsequently lowering the import bill.

Keywords: Popcorn, preparation, cultivation, approved

1. Introduction

Maize is versatile crop and its various types are cultivated in world i.e. flint, dent, baby corn, sweet corn and popcorn etc. Flint and dent are most common types and are of prime importance with maximum share in global maize production. Contrary to former two types, other types are known as specialty corns and are only grown for specified and limited usage. Popcorn is purely grown for eating purpose and is utilized after popping. Popcorn is indigenous to America and its center of origin is South and Central America (Brunson, 1955) [2]. Basically it is a type of flint corn and single mutation was supposed to change it into popcorn (Erwin, 1949) [3] while Brunson (1955) [2] negates the possibility of mutation as the popping ability is a quantitative trait. Popcorn is purely grown for eating purpose and is utilized after popping.

Currently there is no approved variety or hybrid of popcorn in Pakistan therefore either landraces or imported popcorn is being utilized. The use of local landraces results in lower yield as well as inferior popping expansion while import of popcorn is creating extra burden on country economy. Moreover, flakes of landraces and imported popcorn are not as delicious as that of proposed variety. So there was dire need for indigenous popcorn varieties in the country. Maize & Millets Research Institute, Yusafwala Sahiwal has developed a popcorn variety suitable for local agro-ecological conditions with higher yield and better popping expansion.

2. Materials and Methods

The source population of popcorn germplasm is known as pool-20 at Maize & Millets Research Institute Yusafwala Sahiwal. This base population was enriched with the incorporation of three popcorn genotypes of CIMMYT viz: Boya 462, CHZM 134 and Bozm 260 germplasm followed by open pollination in isolation for four seasons to attain

maximum genetic variability. The enriched Pool-20 base population was subjected to five cycles of half sib selection. In this selection method 250 superior plants were selected from base population on the basis of desirable traits especially grain yield. Ears of these selected plants were sown in ear to row fashion in 4:1 (female: male) ratio where male was bulk of all families. Selection was practiced for superior families and for better plants within the selected families to constitute a new base population. The process was repeated for five seasons and finally 10 best performing families, uniform in their morphology and phenology, were selected and subjected to half diallel for all possible combination. The resulting seed was sown in isolation for open pollination and light rouging was practiced for homogenization. The resulting material was sown in isolation for open pollination and light rouging was practiced for homogenization. The developed variety was evaluated at the institute as well as at various places in the country for its yield in comparison to local landrace "Local Swat Popcorn". In addition to yield performance, Agronomic trials were also conducted to find out the optimum plant population and plant geometry to get maximum grain yield. Similarly newly developed variety was screened against stalk rot through artificial inoculation following the rating scale given by Hooker (1956) [6]. The variety was also tested for its grain quality i.e. Protein, fiber, fat and ash using standard method (AOAC, 2000; Guil-Guerrero *et al.*, 1997) [1,5].

3. Results and Discussion

3.1 Station Trials

The variety was tested in station trials for two years before its inclusion in National Uniform Yield Trial and the variety performed better. It gave 107.6% and 53.1% higher yield higher than check variety during Spring 2016 and Kharif 2016 (Table-1). It revealed that variety is very stable in its

genetic potential and has the ability to perform in varying degree of environments.

Table 1: Yield Performance in Micro Plot Maize OPVs Yield Trial

Year of Evaluation	Entries	Grain Yield (Kg/ha)	% Increase/decrease over the check
Spring 2016	Pop-1	6584	107.6
	Local Swat Popcorn	3172	
	CV	8.78	
	LSD	727	
Kharif 2016	Pop-1	4664	53.1
	Local Swat Popcorn	3046	
	CV	11.00	
	LSD	899	

3.2 National Uniform Maize Yield Trials (NUMYT)

After better performance in station trials, seed of Pop-1 was sent to The National Coordinator (Maize, Sorghum, Fodder & Other Cereals) Pakistan Agricultural Research Council (PARC), Islamabad to be included in National Uniform

Yield Trial. The variety was evaluated at six different agro-ecological zones across the country. It gave 47.8% and 26.8% higher yield than the check variety during Spring 2017 and Spring 2018 respectively (Table-2).

Table 2: Yield (kg/ha) Performance in National Uniform Maize (OPVs) Yield Trial

Year of Evaluation	Entries	MMRI (Sahiwal)	AARI (Faisalabad)	NARC (Islamabad)	CCRI Pirsbak	JPL (Arifwala)	Average (Kg/ha)	% Increase/decrease over the check
Spring 2017	Pop-1	5127	4605	3307	5053	537	3726	47.8
	Local Swat Popcorn	4936	2845	1235	4128	168	2662	
	CV	18.2	15.8	14.8	16.3	6.2		
	LSD	320.5	412.8	205.6	391.7	35.9		
Spring 2018	Pop-1	7040	1836	5616				1.7
	Local Swat Popcorn	7040	1776	5432				
	CV	23.3	64.8	44.3				
	LSD	486.5	NS	NS				

3.3 Agronomic Studies

Five plant spacing were compared for obtaining maximum grain yield of Pop-1 during Kharif 2016 and Spring 2017. It is evident from results (Table-3) that plant spacing were significantly different from each other. The variety performed better at plant spacing of 12.5cm with row to row

spacing of 75cm by producing 6358 kg/ha grain yield during kharif season while 20cm spacing was found to be optimum during spring season (6117 kg/ha). Gözübenli and Konuşkan (2010) [7] has already reported significance differences of yield in response to plant spacing.

Table 3: Optimum Plant Spacing for Pop-1 for Higher Grain Yield

-Sr. No	Planting method	Plant spacing	Grain Yield (kg/h)	
Kharif 2016	Ridge sowing	R x R=75cm P x P=12.5cm	6358	
	Ridge sowing	R x R=75cm P x P=15cm	5249	
	Ridge sowing	R x R=75cm P x P=17.5cm	5131	
	Ridge sowing	R x R=75cm P x P=20cm	4965	
	Ridge sowing	R x R=75cm P x P=22.5cm	4511	
	CV			11.66
	LSD			744
Spring 2017	Ridge sowing	R x R=75cm P x P=12.5cm	4493	
	Ridge sowing	R x R=75cm P x P=15cm	4874	
	Ridge sowing	R x R=75cm P x P=17.5cm	6088	
	Ridge sowing	R x R=75cm P x P=20cm	6117	
	Ridge sowing	R x R=75cm P x P=22.5cm	5126	
	CV			3.92
	LSD			257

3.4 Pathological Studies

Disease resistance is critical for a variety to be released for general cultivation therefore the newly developed variety "Pop-1" was tested against stalk rot disease through artificial inoculation at MMRI, Yusafwala Sahiwal. The results (Table 4) showed that Pop-1 was found to be moderately resistant to stalk rot disease during Kharif 2016 and spring 2017. It is also evident that the variety showed a stable behavior against the mentioned disease and remained moderately resistant during both of the years.

Table 4: Disease Reaction of "Pop-1" against Stalk Rot (*Fusarium moniliforme*) by Artificial Inoculation using Hookers Scale

Name of OPV	Stalk Rot Reaction	
	Kharif 2016	Spring 2017
Pop-1	MR	MR

3.5 Quality Analysis

Quality analysis of the variety was performed in Cereal Technology Lab. Wheat Research Institute, AARI Faisalabad to compare it with the check variety. It is evident from the results (Table 5) that Pop-1 has better protein, fat and ash content while lesser quantity of fiber than check. It implies that the nutritional value of newly approved is higher than the local landrace.

Table 5: Quality parameters of Pop-1 in comparison with check variety

Variety	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Ash (%)
Pop-1	7.69	4.27	1.86	1.51
Local Swat Popcorn	6.85	3.58	1.93	1.35

3.6 Justification for Approval

- 1st Open Pollinated Variety (OPV) of popcorn in Pakistan
- 42% more yield than that of check as well as higher popping expansion
- Need of the food industry
- Ability to withstand even at adverse climatic condition e.g. high temperature stress
- Suitable for both seasons (Spring & Autumn)
- Better root anchor/lodging resistant
- Low cost of seed

4. References

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